What stimulates teachers to integrate ICT in their pedagogical practices? The use of digital learning materials in education

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A B S T R A C T

The question “What stimulates teachers to integrate Information and Communication Technologies (ICTs) in their pedagogical practices?” was addressed in the context of teachers’ usage of digital learning materials (DLMs). We adopted Fishbein’s Integrative Model of Behavior Prediction (IMBP), to investigate the various relationships between distal and proximal variables and intention. Mediation analysis revealed that the proximal variables attitude, subjective norm, and self-efficacy towards DLMs were significant predictors of teachers’ intention to use DLMs. The contribution of subjective norm, however, was modest. Attitude, subjective norm and self-efficacy mediated the effects of the following three distal variables on intention: previous use of DLMs, perceived knowledge and skills to use DLMs, and colleagues’ usage of DLMs. Persuasive communication and skills based training seem, therefore, appropriate interventions to promote a positive attitude towards DLMs and improve self-efficacy in using DLMs.

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1. Introduction

Information and Communication Technologies (ICTs) are considered to be a set of tools enabling, supporting, and reinforcing educational reform that fits the educational demands of the knowledge society (Dede, 2000; Ward, 2005). For this reason national (e.g., in the Netherlands: Kennisnet, 2010) and international (e.g., Law, Pelgrum, & Plomp, 2008; Pelgrum & Voogt, 2009) comparative studies have been conducted into teachers’ integration of ICT in their pedagogical practices and into the effects of ICT on the learning outcomes of students. According to Kozma (2003) pedagogical practices are those “organized or patterned sets of activities or interactions used by teachers and students to support and promote learning” (p. 24). One of the findings is that, although the number of teachers using ICT to support learners’ creativity and collaboration has increased, “the percentage of practitioners reporting that they ‘rarely or never’ do this is still high” (Becta, 2008, p. 19). This finding remains valid even when the conditions to use ICT are available (Cuban, 2001) and the body of evidence is growing that usage of ICT can have a positive effect on students’ learning outcomes (Higgins, 2003; Meijer, van Eck, & Felix, 2008). Therefore, the question arises why teachers are reluctant to integrate ICT in their pedagogical practices. In this paper we address the question in the context of teachers’ usage of digital learning materials (DLMs).

The study is performed within the context of the Wikiwijs initiative. Wikiwijs was launched by the Dutch ministry of Education, Culture and Science to stimulate the use of DLMs, specifically Open Educational Resources in primary, secondary as well as higher education (Plasterk, 2009). Although a recent study (TNS NIPO, 2009) showed that over 70% of the primary and secondary school teachers in the Netherlands use ICT for educational purposes, the same study also showed that these ICT are mostly used outside the classroom. Most teachers reported using a word processor and the Internet to search for information. Less than 25% of the teachers indicated using ICT in more innovative ways, such as DLMs usage in the classroom. Therefore, the current study focuses on the pedagogical use of DLMs in the classroom in order to reveal factors that facilitate or inhibit this usage. Identification of these factors informs the design of appropriate interventions that may be beneficial for the success of the Wikiwijs initiative. In this study, DLMs must be understood in a broad sense, including video clips (e.g., a YouTube fragment), simulations (e.g., simulation of an electronic circuit), illustrations (e.g., photos and drawings), and computerized tests. We further refer to the report of Kennisnet (2010) that presents a complete overview of the state of affairs regarding ICT use by Dutch primary and secondary school teachers and issues related to that ICT use (e.g., ICT infrastructure, training).
2. Theoretical framework

In the present study, the Integrative Model of Behavior Prediction (IMBP, see Fishbein, 2000) is used, which is largely based on the theory of planned behavior (TPB, see Ajzen, 1991; Fishbein & Ajzen, 2010). IMBP is a well-known theory in the domain of health education and health care (see, for example, Yzer, Capella, Fishbein, Sayeed, & Ahern, 2004) but in this study it is applied to the domain for the advancement of the integration of ICT in teachers’ pedagogical practices (see for this Kreijns, Vermeulen, Kirschner, van Buuren, & Van Acker, in press). In IMBP, proximal variables play a key role in the cognitive process of self-regulation with respect to the desired behavior, here teachers’ usage of DLMs in education. IMBP posits that a person will perform a particular behavior (i.e., using DLMs) only if that person has formed the intention to perform that behavior. Intention to use DLMs, thus is a proximal measure of actually using DLMs. The benefit in using this variable is that it enables to assess the effectiveness of interventions for stimulating the usage of DLM – as the target of the behavior change – even if there are no readily available measures of actual behavior or the behavior has not yet been performed (Ajzen, 1991; Fishbein & Ajzen, 2010; Francis et al., 2004). Using intention as a proxy for behavior is, however, somewhat limited because the relationship between intention and behavior is moderated by contingency variables that may impede real usage of DLMs (e.g., the appropriate DLMs are not available) and by teachers’ actual knowledge and skills (e.g., to use DLMs in a pedagogical manner). Nonetheless, research had consistently shown that there is a strong relationship between intention and actual behavior (Ajzen, 1991; Fishbein & Ajzen, 2010).

In IMBP the three proximal variables attitude, subjective norm, and self-efficacy towards using DLMs are the immediate antecedents of teachers’ intention to use DLMs in their pedagogical practices. Attitude towards using DLMs is the person’s overall feeling of sympathy or antipathy towards the consequences or outcomes of using DLMs. The antecedent variables of attitude are the evaluations and outcome beliefs teachers have should they use DLMs. In the perspective of IMBP, outcome beliefs are formulated in terms of expectancies (i.e., probabilities) about the performance of the behavior having certain consequences or outcomes, either positive/advantageous (e.g., DLMs give more variations during class) or negative/disadvantageous (e.g., DLMs require more class preparation). The evaluations of those outcome beliefs state how important/desirable or unimportant/undesirable these outcomes are. Evaluations are, therefore, expressed in terms of importance or in terms of desirability.

Subjective norm towards using DLMs is the aggregated person’s beliefs that most people who are important to that person may think that he or she should use DLMs. In that sense, subjective norm reflects a pressuring form of social influence (Ajzen, 1991; Fishbein & Ajzen, 2010). The antecedent variables of subjective norm concern the normative beliefs teachers have that important people (e.g., school administration, colleagues, parents, etcetera) may think that they should use DLMs. Normative beliefs are expressed in terms of expectancies or probabilities about these beliefs to be true (e.g., it is very likely that my direct colleagues think that I should use DLMs; it is unlikely that my pupils think that I should use DLMs). Moreover, normative beliefs are weighed by the person’s motivation to comply, that is, the extent to which the person wishes to comply with the thinking of these important people.

Self-efficacy refers to “people’s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives” (Bandura, 1991, p. 257). Self-efficacy in the context of teachers’ usage of DLMs, concerns the convictions teachers have that they can use DLMs and that they can overcome the impediments that hinder the use of DLMs. More precisely, self-efficacy concerns the teachers’ belief about his or her capabilities to use DLMs pedagogically in the classroom. In other words a teacher is to some degree confident that he or she can find and select appropriate DLMs from various (Internet) sources and know how to integrate them successfully in the own lessons. In addition, a teacher has beliefs that the DLMs can be handled instrumentally. That is for example, he is to some degree confident that he can download a YouTube fragment and convert it into a more suitable format for storing and displaying. Finally, a teacher is to some degree confident that the obstacles they encounter can be handled with when using the DLMs, for example, finding alternative Internet sites when a particular site with very interesting video fragments about volcano eruptions has ceased to exist.

In an extensive review, Mumtaz (2000) reported that attitude and self-efficacy have been identified in several studies as important predictors of teacher’s ICT usage. Two of those studies explicitly mentioned that a positive attitude towards ICT alone is not a sufficient condition for teachers to use ICT. According to Mumtaz, in order to actually use ICT in the classroom, teachers need to be sufficiently confident that they will be effective in doing so; in other words, teacher’s self-efficacy needs to be sufficiently high.

Fig. 1 displays the general IMBP adapted for the domain for the advancement of the integration of ICT in teachers’ pedagogical practices. The original model has been changed to reflect the target behavior (i.e., using DLMs) and extended to include several possible distal variables that determine this behavior. This figure shows that the variables are grouped into proximal, distal and ultimate variables. The distal variables encompass all the variables at the level of teachers’ characteristics and school organization, and the ultimate variables the variables at the level of local, regional, and governmental organization. In the current study, not all variables depicted in Fig. 1 were included in our study, only the variables in the gray areas were used.

An important aspect of IMBP is that it posits that the behavior under study should be sufficiently specific. That is, it must be made clear whether the behavior concerns, for example, the use of a digital white board, an electronic learner portfolio, or the use of DLMs. Indeed, teachers may have the intention to use a digital white board and DLMs but – at the same time – not have the intention to use an electronic learner portfolio. Although some work mentioned in the Mumtaz review (2000) studied specific ICT applications, most studies reported attitudes and self-efficacy with respect to ICT use in general. Studying the broad field of pedagogical ICT applications poses an important problem, as participants may consider other types of ICT usages when completing a research instrument (e.g., some may think of using a digital white board, while others could envision using DLMs or an electronic learner portfolio). Therefore, the present paper will focus on using DLMs in the classroom as the specific behavior being studied. As a consequence, attitude and self-efficacy, as well as subjective norm are studied in the context of pedagogical DLM usage, and not in relation to general ICT use. Moreover, DLM usage has received little attention until now and therefore studying this specific behavior seems warranted.

In the present study we thus investigate the effects of three distal variables on the proximal variables attitude, subjective norm, and self-efficacy towards the intention to use DLMs. Although IMBP posits that the direct antecedents of attitude, subjective norm and self-efficacy are respectively outcome beliefs, normative beliefs and efficacy beliefs (as can be observed in Fig. 1), these are often omitted in empirical studies for reasons of feasibility and simplicity. For the same reasons we will not consider these beliefs in the current study.
With respect to the first distal variable of interest, previous use of DLMs, many IMBP/TPB scholars suggest that, in general, past behavior is a good predictor for the intention to perform the same behavior in the future, provided that everything else that may affect the behavior remains unchanged (e.g., Ouellette & Wood, 1998). This latter condition is particularly important because when, for example, schools change from PCs to Apple iPad devices, they may experience that certain content cannot be viewed because specific formats are not supported. If no alternative DLMs can be found then teachers who depend on those DLMs may either stop using them or change the playback device. Generally, past behavior may not only influence attitude towards the behavior because of its expected outcomes that have turned out to be true or false, but also feelings of competence because the performance of the behavior could or could not be demonstrated and, thus, of self-efficacy (c.f., Hagger, Chatzisarantis, & Biddle, 2001). In an earlier study on the importance of attitude and self-efficacy in relation to ICT usage, it was found that previous ICT use was a significant predictor of self-efficacy and the intention to further implement ICT in teaching activities (Cox, Preston, & Cox, 1999). Moreover, based on studies from the last century, Mumtaz (2000) concluded that teachers often lack the necessary training to successfully implement ICT into their pedagogical practice. It seems, therefore, unlikely that teachers have intensively used DLMs previously. For these reasons, we will focus in the current study on previous pedagogical DLM use as a predictor of attitude, subjective norm and self-efficacy.

With respect to the second distal variable, perceived knowledge and skills to use DLMs in the classroom, several scholars in the domains of information systems (ISs) and of education and ICT have investigated the relationship between computer competence and computer self-efficacy. For example, Doyle, Stamouli, and Huggard (2005) studied the mutual relationships between computer experience, computer anxiety, and computer self-efficacy amongst computer science students. Computer experience was measured by assessing the amount of computer use, opportunities to use computers and diversity of experience with regard to computers. As such it served as an indicator of perceived knowledge and skills regarding computers. They concluded that as computer experience increased a significant increase in self-efficacy was observed. But, whereas Doyle, Stamouli and Huggard found that the antecedent of computer self-efficacy is computer experience, Shih (2006) found the opposite relationship: “[t]he empirical results identified [computer] self-efficacy as a strong and positive antecedent of [computer] competence” (p. 1012). Questions, thus, remain about the precise causality of this effect. In this study we assume that perceived knowledge and skills is an antecedent of self-efficacy.

Perceived knowledge and skills also seem to influence attitude. A study of Birgin, Çatlıoğlu, Gürbüz, and Aydn (2010) investigated the relationship between experiences of pre-service mathematics teachers with computers and attitudes towards them. They concluded that “teachers’ attitudes towards computers differ according to their years of study, computer ownership, level of computer competency, frequency of computer use, computer experience, and whether they had attended a computer-aided instruction course” (p. 512), thus supporting the relationship and its direction suggested by IMBP. But again, other researchers found that computer competence is not the antecedent of computer attitude, but that attitude is the antecedent of computer competence. Jegede, Dibu-Oyerinde and Ilori (2007) reported from their study that “[f]indings revealed that [computer] attitude bears a significant relationship with and also predicts [computer] competence” (p. 172). They explained their finding as follows: “[i]t was observed that as teachers perceived computers to be useful in their pedagogical enterprise, the interests become aroused which in turn helps their computer skills” (p. 172). Nevertheless, despite the fact that there are confounding issues concerning the causal direction of the relationships between perceived knowledge and skills and self-efficacy, and between perceived knowledge and skills and...
attitude, the present study considered perceived knowledge and skills to use DLMs to be distal to both self-efficacy and attitude towards using DLMs, consistent with IMBP and TPB. However, we acknowledge that a positive attitude towards the use of DLMs may motivate teachers to take action to increase their knowledge about how to use DLMs in their pedagogical practices.

Finally, the last distal variable of interest (i.e., colleagues’ use of DLMs) is a particular form of social influence, namely, the descriptive norm. Whereas the subjective norm represents the injunctive qualities (i.e., what ought to be done), the descriptive norm represents, as its name already implies, the descriptive qualities (i.e., what already is done) of the social pressure (Fishbein & Ajzen, 2010; see also Cialdini, Reno, & Kallgren, 1990; Deutsch & Gerard, 1955; Rijvis & Sheeran, 2003). Thus, the descriptive norm expresses that the mere fact that a relevant reference group (e.g., colleagues) are performing the desired behavior, may exert an effect on intention via attitude, subjective norm, and self-efficacy. However, different settings and populations may determine how this effect on attitude, subjective norm, and self-efficacy is formed. For example, if low self-efficacy teachers see that even their colleagues who are perceived as not capable to use ICT are successfully using DLMs then those reluctant teachers may become convinced that they were wrong about their judgments of their own capacity to use DLMs. As a result, their self-efficacy may get a boost. The latter phenomenon is reflected in the phrase ‘If even they can do it, I certainly can do it.’ The fact that colleagues are using DLMs may also improve the teachers’ attitude towards using DLMs. It is argued that teachers may think that if so many colleagues are using DLMs, then there must be something good in it otherwise they would not use it. This reasoning may alter teachers’ initial attitudinal disposition to become more positive about the use of DLMs in their classes. Finally, the descriptive norm may influence motivation to comply – the extent to which teachers wish to identify themselves with those colleagues who use DLMs - and, thus, the subjective norm. For example, teachers may wish to be like their colleagues of the same section or team and, therefore, strive to identify themselves with these teachers by adopting the section’s or team’s norm. Then, if the descriptive norm holds that DLMs are to be used, those teachers will most probably use DLMs during class.

3. Research questions and hypotheses

Two questions were addressed in the present study: Question 1: is each of the proximal variables attitude, subjective norm, and self-efficacy towards using DLMs in the classroom related to teachers’ intention to use DLMs in their pedagogical practices? Question 2: What is the influence of each of the following three distal variables: previous use of DLMs, perceived knowledge and skills to use DLMs, and colleagues’ usage of DLMs on the three proximal variables attitude, subjective norm, and self-efficacy?

Based on these research questions and the findings from previous research reported in the introduction, we formulated the following hypotheses:

Hypothesis 1. The proximal variables influence intention to use DLMs.

(1.1) Attitude towards using DLMs positively influences intention to use DLMs.

(1.2) Subjective norm towards using DLMs positively influences intention to use DLMs.

(1.3) Self-efficacy in using DLMs positively influences intention to use DLMs.

Hypothesis 2. The distal variables influence the three proximal variables.

(2.1) Previous use of DLMs shows positive relations with attitude towards using DLMs and self-efficacy in using DLMs.

(2.2) Colleagues’ usage of DLMs (descriptive norm) positively influences attitude towards using DLMs, subjective norm towards using DLMs, and self-efficacy in using DLMs.

(2.3) Perceived knowledge and skills to use DLMs positively influence attitude towards using DLMs and self-efficacy in using DLMs.

Hypothesis 3. The influence of the distal variables on intention to use DLMs is mediated by the three proximal variables.

(3.1) The relation between previous use of DLMs and intention to use DLMs is mediated by attitude towards using DLMs and self-efficacy in using DLMs.

(3.2) The relation between colleagues’ usage of DLMs (‘descriptive norm’) and intention is mediated by attitude towards using DLMs, subjective norm towards using DLMs, and self-efficacy in using DLMs.

(3.3) The relation between perceived knowledge and skills to use DLMs and intention to use DLMs is mediated by attitude towards using DLMs and self-efficacy in using DLMs.

4. Method

4.1. Participants

A questionnaire was administered electronically in December 2009 to a representative sample of teachers of primary and secondary schools to investigate their use of DLMs. Participants were part of an existing panel that includes a representative sample of the Dutch population. A total of 1209 responses were collected. Distributions of the sample with respect to school type, gender and age can be found in Table 1. This distribution is similar to the population distribution (CBS, 2009).

4.2. Measures

4.2.1. Proximal variables

The questionnaire included measures for the intention to use DLMs, the proximal and distal variables of interest, and also included a demographics section. The measures for the proximal variables attitude, subjective norm, and self-efficacy were either adapted from existing measures or newly constructed thereby following the principles of Ajzen (Ajzen, 2010; Fishbein & Ajzen, 2010; see also Francis et al., 2004). These principles state that rather than a general behavior (e.g., the teachers’ usage of ICT) a specific behavior should be the focus of the research. As the study focuses on teachers’ usage of DLMs, the behavior is specific and in compliance with the principles. The principles further state that the TACT condition needs to be fulfilled as well as the principle of compatibility for all proximal variables. For the TACT condition to hold, items of the measures must specify target, action, context and timing. Therefore, we have formulated items of, for example, intention as ‘I intend to use digital learning material during class.

Table 1

<table>
<thead>
<tr>
<th>School type</th>
<th>Gender</th>
<th>Age M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary school (N = 710)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>130 (18.13%)</td>
<td>580 (81.87%)</td>
</tr>
<tr>
<td>Women</td>
<td>285 (57.11%)</td>
<td>214 (42.89%)</td>
</tr>
<tr>
<td>Secondary school (N = 499)</td>
<td></td>
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regularly," where regularly was specified as ‘a few times a week during the school year’. As such, the DLMs formed the target and the context was defined by the classroom; action was the use of DLMs. Finally, the specification of regularly defined the timing. The principle of compatibility implies that all other items of the different measures should be formulated in a similar manner. Therefore, for example, attitude was formulated as ‘For me, to use digital learning materials during class regularly is . . .’ where participants had to score six bipolar items (e.g., ‘boring—fun’). All measures used seven-point rating scales for Likert type items as well as for bipolar items.

Intention to use DLMs was measured with four items that are common for the measurement of behavioral intention (see Ajzen, 2010; Fishbein & Ajzen, 2010; Francis et al., 2004). A sample item was ‘I plan to use digital learning materials during class regularly.’ Labels accompanying the rating scale were ‘absolutely unlikely’ to ‘extremely likely.’

The instrument used to measure attitude towards using DLMs reflected an instrumental as well as an affective or experiential dimension (Ajzen, 2010; Fishbein & Ajzen, 2010). Three bipolar items (valuable–worthless, meaningful–meaningless, and useless–useful) were used to assess the instrumental dimension and three other items (boring–fun, dull–exciting, and fantastic–horrible) to gauge the affective dimension.

Subjective norm was measured with a single item: ‘Taking everything into account, to what degree do you experience social pressure from your school administration, team leaders, colleagues, parents, etcetera to use digital learning materials during class regularly?’ Possible answers were ‘absolutely no pressure’ to ‘extremely much pressure.’

Self-efficacy was assessed with a single item: ‘I am confident that I can use digital learning materials during class regularly.’ Answer options were ‘completely not applicable’ to ‘completely applicable.’

4.2.2. Distal variables

Previous use of DLMs was assessed by asking respondents how often they have previously used DLMs using one item: ‘How often did you use digital learning materials, in particular materials that contain pictures, illustrations, video clips, animations and sound fragments?’ Answers were given on a 7-point scale ranging from ‘never’ to ‘a few times a day.’

Perceived knowledge and skills to use DLMs was assessed by asking respondents about their experience/knowledge and skills with using DLMs. One item was used: ‘To what degree do you have experience/knowledge and skills with using digital learning materials, in particular materials that contain pictures, illustrations, video clips, animations and sound fragments?’ Answers were ‘definitely no experience at all’ to ‘definitely experienced.’

Colleagues’ usage of DLMs, representing the descriptive norm, was assessed by three items. A sample item was ‘Most of my colleagues of the other sections/teams at my school use digital learning materials during their classes regularly.’ Possible answers were ‘completely not applicable’ to ‘completely applicable.’

4.3. Analysis

Relationships between the measured variables were analyzed using bivariate correlations (see Table 2). Preacher and Hayes’ (2008) method for testing indirect effects was used to confirm our mediation hypotheses. This method tests four different relationships using regression analysis:

1. Whether there is a significant direct relationship between the mediator (i.e., attitude, self-efficacy, and subjective norm) and the outcome variable (i.e., intention to use DLMs).
2. Whether there is a significant direct relationship between the independent variable of interest (i.e., previous use of DLMs, perceived knowledge and skills to use DLMs, and colleagues’ usage of DLMs) and the mediator.
3. Whether the indirect effect of the independent variable on the outcome variable, through the mediator, is significant (using a bias corrected and accelerated bootstrap method, which does not assume normally distributed data and generally has more power).
4. Whether the direct effect of the independent variable remains significant after controlling for the mediation effect (i.e., whether there is full or partial mediation).

To obtain standardized regression coefficients, standardized values were calculated for all of the variables prior to the analysis. Age and gender were added as covariates in the analyses. Two outliers were detected using multiple linear regression analysis and were therefore removed. The latter was based on the Mahalanobis distance (Barnett & Lewis, 1978).

5. Results

Table 2 displays the internal consistency (Cronbach’s alpha) and the descriptive statistics for the seven scales used. Multi-item scales were found to have a high to very high internal consistency. In Fig. 2 the conjectured direct relationships between intention to use DLMs and the other variables are shown schematically. In total, 68% of the variance in intention to use DLMs was explained by the variables in the model (R² = .68; F(8, 1198) = 322.65, p < .001). Gender and age showed no significant relationship with the intention to use DLMs.

Concerning Hypothesis 1, being that the proximal variables influence intention to use DLMs, the regression analyses revealed that a considerable part of the variance in intention is explained by attitude, subjective norm and self-efficacy. Attitude has the largest contribution (β = .49, p < .001) followed by self-efficacy (β = .32, p < .001). Subjective norm has the smallest effect on intention (β = .10, p < .001). Hypothesis 1 is hereby confirmed.

With regard to Hypothesis 2, it was expected that the distal variables previous use of DLMs, perceived knowledge and skills to use DLMs, and colleagues’ usage of DLMs influence the proximal variables attitude, subjective norm and self-efficacy. This is tested in the path model in Fig. 2. It can be observed that each of the distal variables influences attitude, self-efficacy as well as subjective norm. However, the results show some differences between the variables. Firstly, it can be noted that the influence of all three distal variables (previous use of DLMs, perceived knowledge and skills to use DLMs, and colleagues’ usage of DLMs) on self-efficacy, is very similar (respectively β = .17; β = .22; β = .21, all p’s < .001). The same can be observed for the influence of the distal variables on attitude (respectively β = .20; β = .17, β = .20, all p’s < .001). For subjective norm, however, the relationships with the distal variables seem to differ more. Whereas colleagues’ usage of DLMs and previous use of DLMs have a positive relationship with subjective norm (respectively β = .17 and β = .13, all p’s < .001), perceived knowledge and skills to use DLMs shows a negative correlation (β = -.13, p < .001). Based on these results Hypothesis 2 can be confirmed.

As can be observed in Table 3, our third hypothesis, being that the influence of the distal variables on intention is mediated by the three proximal variables is confirmed as well.

The results in Table 3 show the bootstrapped confidence intervals around the estimated indirect effects, which indicate that all of the studied distal variables influence intention through all three of the proximal variables. Based on the confidence intervals in Table 3,
all proposed mediating effects can be considered significant, hereby confirming Hypothesis 3.

Finally, Fig. 2 shows that there is a small but still a significant direct effect of previous use of DLMs and colleagues' usage of DLMs (p's < .001) on the intention to use DLMs after controlling for the effects of the mediators (respectively β = .13 and β = .07). It must thus be concluded that the proximal variables mediate the effects of our distal variables partially.

6. Discussion and conclusion

The purpose of this study was to test whether IMBP is able to explain what motivates teachers to integrate ICT in their pedagogical practices, more specifically to use DLMs in the classroom. To explain the intention to use DLMs, two types of variables are distinguished in the model. The first type is represented by the proximal variables in IMBP that explain intention to use DLMs; these variables are attitude, subjective norm, and self-efficacy. In turn, these variables are explained by the second type of variables which are the distal variables. In this study we selected previous use of DLMs, colleagues' usage of DLMs and perceived knowledge and skills to use DLMs as distal variables. IMBP purports that the proximal variables function as a mediator between the distal variables and the intention to use DLMs. All relations between the distal and the proximal variables, as well as the proposed mediating effects, were confirmed. Our results thus seem to provide support for the appropriateness of the IMBP for the domain of teachers' use of DLMs in the classroom.

Nonetheless, there were some unexpected relationships. First, previous use of DLMs and perceived knowledge and skills to use DLMs also seem to impact on subjective norm. Moreover, perceived knowledge and skills shows a negative relationship with subjective norm. The more teachers feel they are sufficiently skilled in using ICT the less they seem to experience external pressure in using DLMs. Teachers who feel they lack sufficient ICT skills may experience more external pressure, because the behavior they are expected to show is less evident. Future studies could try to further explain our finding. With respect to the impact of previous use on subjective norm, it would seem that the more frequent teachers have previously used DLMs, the more they feel pressured to do so in the future. Positive outcomes of the teachers' behavior may be the cause of this, as students may expect their teachers to make more use of DLMs after they have previously shown to be successful in integrating them into their teaching.

Second, there were direct effects of previous use of DLMs and colleagues' usage of DLMs on intention. These direct effects may be explained as follows. With respect to the first (i.e., previous
use of DLMs), previous research has found that past behavior is a good predictor of the intention to perform the same behavior in the future (Cox et al., 1999; Ouellette & Wood, 1998). In other words, previous research actually suggested a direct effect of past behavior on intention. However, IMBP purports that effects of distal variables are mediated by the proximal variables. This necessarily led us to hypothesize that the effect of previous use of DLMs on intention is indirect. However, because of our finding, we must agree with previous research that there is indeed a direct effect of previous use of DLMs on intention and that this was not foreseen by IMBP. With respect to the latter (i.e., colleagues’ usage of DLMs), Fishbein and Ajzen (2010) were vague about whether colleagues’ usage of DLMs (i.e., the descriptive norm) is a distal or proximal variable. They advised to assess both descriptive norm and subjective norm to represent ‘perceived norm,’ which has a direct effect on intention. But, at the same time, they admitted that descriptive norm can also have indirect effects. We have considered colleagues’ usage of DLMs as a distal variable because it is a form of social influence at the distal level as it also influences attitude, self-efficacy, and subjective norm. This corresponds with Fishbein and Ajzen’s original use (that is, the use before 2010) of the variables descriptive norm and subjective norm and which is reflected in IMBP (introduced in 2000, see Fishbein, 2000). Indeed, Fishbein and Ajzen (2010) stated that “In contrast to our original use of the term subjective norm, which referred to only injunctive norms, the normative component in the Integrative Model (Fishbein, 2000) and in our current theoretical framework captures the total social pressure experienced with respect to a given behavior. It is assumed that this perception incorporates and integrates both the desires [subjective norm] and the actions [descriptive norm] of important referent individuals and groups” (p. 131). Because of our findings, we must agree with the present thinking of Fishbein and Ajzen that colleagues’ usage of DLMs indeed has direct as well as indirect effects.

The structural relations that were found have several important implications. Attitude was found to have the strongest relationship with intention to use DLMs, followed by self-efficacy, thereby supporting the findings of Mamtaz (2000). The correlation between subjective norm and intention was rather weak. Attitude is thus one of the most important predictors of DLM use. In order to explore how attitude can be influenced, the relationships between attitude and three distal variables were tested. Previous use of DLMs, colleagues’ usage of DLMs as well as perceived knowledge and skills to use DLMs in the classroom seemed to have an equally important impact on attitude. In order to achieve a positive attitude towards using DLMs, teachers need to have sufficient ICT skills. Moreover, they also need to see that other teachers are using them. The latter may probably relate to the outcome expectations teachers have towards using DLMs: observing other teachers’ DLM use and talking about it at school may provide realistic views of what advantages and disadvantages this behavior holds. A similar explanation can be given for the impact of previous use of DLMs: in the case this previous behavior had positive outcomes, teachers may get a more favorable attitude towards using DLMs. Although the three distal variables under consideration show a positive relationship with attitude, they only explain part of its variation. It should be studied how other variables stated in IMBP relate to attitude in order to fully explore the impact attitude has on teachers’ intentions to use DLMs or ICT in general (see the non-gray areas in Fig. 1).

The influence of the colleagues’ usage of DLMs via the subjective norm on intention is significant but weak. A possible explanation for this can be found in the social identity or self-categorization theory (SI/SCT, see Hogg & Terry, 2000; Tajfel, 1978). SI/SCT posits that people tend to adopt the norms and values of a behavioral relevant reference group to the extent they wish to identify themselves with that group (i.e., to the extent their social identity prevails their individual identity). Applied to IMBP, SI/SCT suggests that identifiers to a social group (e.g., the colleagues) will be mainly influenced by the descriptive and subjective norm of the group. Non-identifiers, on the other hand, will rather be influenced by their own attitude and self-efficacy, which are dispositions associated with the individual (Terry & Hogg, 1996). In general, teachers form a population that is difficult to be influenced by others (McDaniel, Neellemann, Schmidt, & Smaling, 2009). In other words, a teachers’ individual identity is fairly dominant, and external influences are somehow suppressed, regardless of the source of these influences.

Self-efficacy was expected to be mainly determined by perceived knowledge and skills as well as previous use, but was found to be almost equally determined by the descriptive norm. Indeed, as argued before, teachers may feel more convinced of being able to use DLMs when they see that their colleagues (who are probably as skilled as themselves) are successful in making use of DLMs in their courses.

It needs to be remarked that encouraging the use of DLMs resembles a self-reinforcing system. Previous use and the use of colleagues increases the intention to use DLMs. However, if no one starts using DLMs, then colleagues would not use them and, hence, these positive influences will not occur. Therefore, different actions need to be undertaken to increase the use of DLMs. First, interventions aimed at increasing the use of DLMs in teachers’ pedagogical practices should focus on improving teachers’ self-efficacy, for example, by providing them with skills based training programs and by encouraging experimental behavior with respect to using DLMs and ICT in general.

Although the advice to provide skills based training programs seems to be an open door, tight budgets usually prevent schools to let all teachers participate in these training programs, with the result that only few teachers are allowed to attend these programs. Therefore, the opportunity for teachers to professionalize themselves in the pedagogical use of DLMs is, at present, rather limited. Also, ICT is continuously improving and new features are introduced and, thus, DLMs are becoming more advanced, teachers need to update their knowledge and skills, implicating that attending training programs is not a one-time activity but has to be repeated on a regular basis. In other words, attending skills based training programs should be a recurring activities in the professionalization trajectories of all teachers (Lawless & Pellegrino, 2007). However, given the fact that professional development opportunities are limited, this will be rather difficult to realize. Apart from this, there is another issue that has to addressed, namely the low availability of skills based training programs with respect to the pedagogical integration of ICT into teachers’ practices. These programs rarely go beyond the traditional approach of showing teachers how to use or operate the ICT tools (Lawless & Pellegrino, 2007), and this may particularly be true for the case of DLMs. Workplace learning that includes experimental behavior may compensate some of the problematic issues of training programs. Experimental behavior is usually characterized by the inclusion of design-based components. According to Lawless and Pellegrino (2007), a design-based approach “affords teachers the opportunity to learn how to use the specific technologies [DLMs] situated in the context of their curricular needs” (p. 549). They further stated that as a result, “teachers take more ownership of the resources [DLMs], have higher confidence in integrating the unit as a teaching tool, and are more likely to believe that the curriculum resources will have a positive effect on student achievement” (p. 549). In short, it is suggested that experimental behavior with design-based components increases feelings of self-efficacy and attitude toward the use of DLMs.

We also found that subjective norm was weak amongst teachers. Previous research on educational ICT use has shown that
transformational management seems to support a climate which stimulates innovation (Aryee, Walumbwa, Zhou, & Hartnell, 2012), such as ICT use (Geijsel, Sleegers, & Van den Berg, 1999). In order to increase subjective norm, we therefore propose that a more transformational management should provide a clear vision on the importance of pedagogical DLM use, as well as a realistic ICT policy, and implementation strategy in the school. Transformational management should also provide conditions that stimulate professional development. These conditions should include removing problematic issues surrounding the skills based training programs, and require teachers to keep a portfolio so that their progress can be monitored. Such initiatives show teachers that the pedagogical use of DLMs is a serious matter in their school, which could in turn increase the probability that these teachers feel more pressured to use DLMs.

7. Future research

Future research should focus on other antecedent variables of attitude and self-efficacy regarding the use of DLMs. That is, on teachers’ positive and negative outcome beliefs and their evaluations should they use DLMs, and on teachers’ efficacy beliefs regarding how they think to cope with the impeding factors that are associated with DLMs use. Future research should also consider other distal variables than the ones used in this study (see Fig. 1 to get an impression). Moreover, it would be interesting to validate our findings using qualitative research methods as well. In addition, the relationship between intention and actual behavior regarding the use of DLMs deserves further study, that is, whether teachers will actually use DLMs when they say that they intend to use DLMs in their classrooms. Indeed, previous research on the intention–behavior relationship showed that although intention is considered as a strong predictor for actual behavior, it is nonetheless true that often people do not convert their intentions into actual behavior (Fishbein, Hennessy, Yzer, & Douglas, 2003).

Finally, we will take a closer look at the professional development activities and their evaluations, thereby using the guidelines derived from the three phase evaluation design model of Lawless and Pellegrino (2007). This design model identifies three sequential phases which focuses on different key questions related to three different aspects of professional development. In a first phase, the type, the content and the duration and the required support of professional development need to be scrutinized. During phase two, teacher outcomes such as knowledge, attitudes and behavior, need to be examined. The third phase consists of an assessment of possible changes in teachers' behavior as well as effects of teachers' development of student outcomes. In sum, this model allows for an overall assessment of the effectiveness of teachers’ professional development and could provide insight into the core qualities of the development programs.

Appendix A. Measures of intention as well as the proximal and distal variables

<table>
<thead>
<tr>
<th>Intention</th>
<th>Please indicate to what extent the following statements apply to you:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I plan to use digital learning materials during class regularly</td>
<td>7 = ‘extremely likely’ – 1 = ‘absolutely unlikely’</td>
</tr>
<tr>
<td>2. I intend to use digital learning materials during class regularly</td>
<td></td>
</tr>
<tr>
<td>3. I think I should use digital learning materials during class regularly</td>
<td></td>
</tr>
</tbody>
</table>

### Measures of intention as well as the proximal and distal variables

| 1. I intend to use digital learning materials during class regularly | 7 = ‘very likely’ – 1 = ‘absolutely unlikely’ |
| 2. I plan to use digital learning materials during class regularly | |
| 3. I think I should use digital learning materials during class regularly | |

#### Attitude

| Please indicate to what extent the following statement applies to you: |
| 1 = ‘absolutely unlikely’ – 7 = ‘extremely likely’ |

| 1. Valuable–worthless |
| 2. Meaningful–meaningless |
| 3. Useless–useful |
| 4. Boring–fun |
| 5. Dull–exciting |
| 6. Fantastic–horrible |

#### Self-efficacy

| Please indicate to what extent the following statement applies to you: |
| 1 = ‘definitely no experience at all’ – 7 = ‘definitely experienced’ |

| 1 = ‘never’ – 7 = ‘a few times a day’ |

#### Subjective norm

| Please indicate to what extent the following statement applies to you: |
| 1 = ‘completely not applicable’ – 7 = ‘completely applicable’ |

| 1 = ‘absolutely no pressure’ – 7 = ‘extremely much pressure’ |

| 1 = ‘never’ – 7 = ‘a few times a day’ |

#### Previous use of DLMs

| Please indicate to what extent the following statement applies to you: |
| 1 = ‘never’ – 7 = ‘a few times a day’ |

| To what degree do you have experience/knowledge and skills with using digital learning materials, in particular materials that contain pictures, illustrations, video clips, animations and sound fragments? |

| 1 = ‘definitely no experience at all’ – 7 = ‘definitely experienced’ |

| 1 = ‘always’ – 7 = ‘never’ |

#### Perceived knowledge and skills to use DLMs

| Please indicate to what extent the following statement applies to you: |
| 1 = ‘always’ – 7 = ‘never’ |

| To what degree do you feel more pressured to use DLMs. |

| 1 = ‘low’ – 7 = ‘high’ |

#### Colleagues’ usage of DLMs

| Please indicate to what extent the following statements apply to you: |
| 1 = ‘absolutely unlikely’ – 7 = ‘extremely likely’ |

| 1 = ‘definitely no experience at all’ – 7 = ‘definitely experienced’ |

| 1 = ‘always’ – 7 = ‘never’ |

| To what degree do you feel more pressured to use DLMs. |

| 1 = ‘low’ – 7 = ‘high’ |
3. Most of my colleagues of the schools use digital learning materials during their classes regularly
1 = 'completely not applicable' – 7 = 'completely applicable'

Regularly = 'a few times a week during the school year'.

References


